Sept. 2, 1930. E. D. COOK 1,775,019

SYNCHRONIZING REPRODUCING APPARATUS

Filed Sept. 12, 1929

Fig. 1.

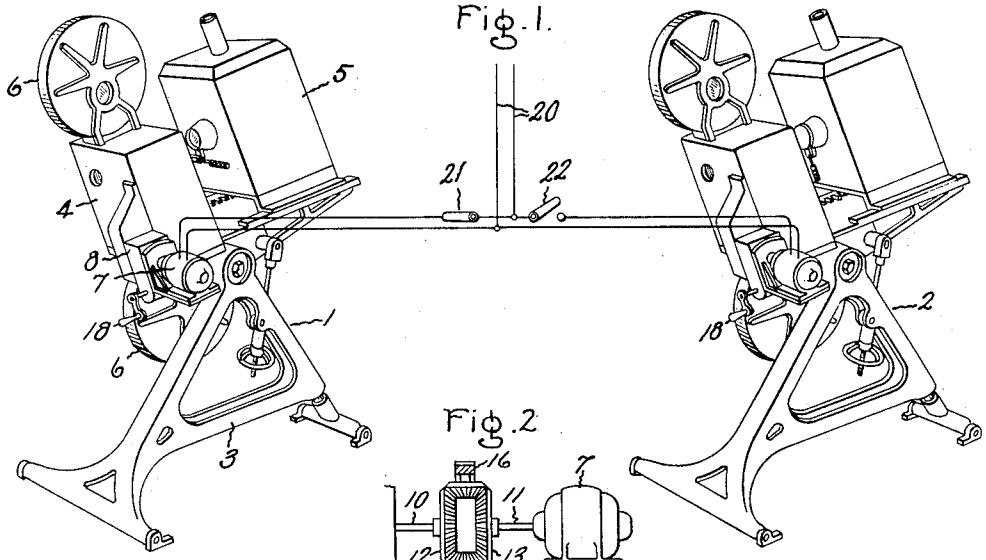
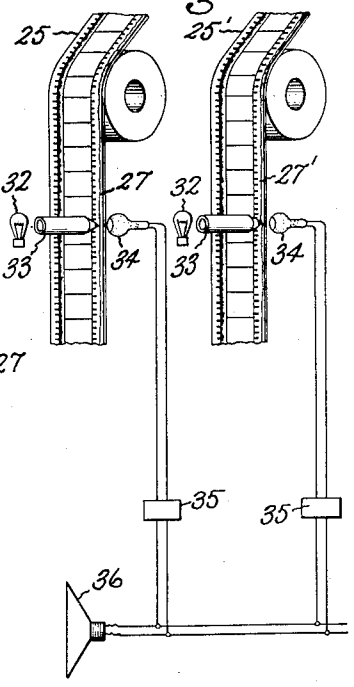


Fig. 2

Fig. 6.



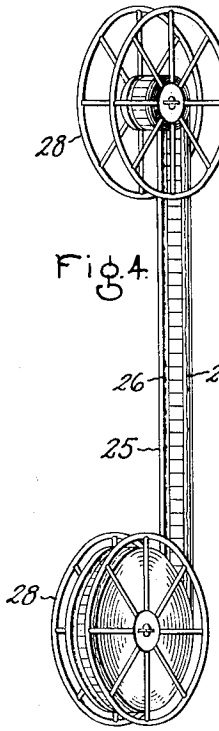


Fig. 4.

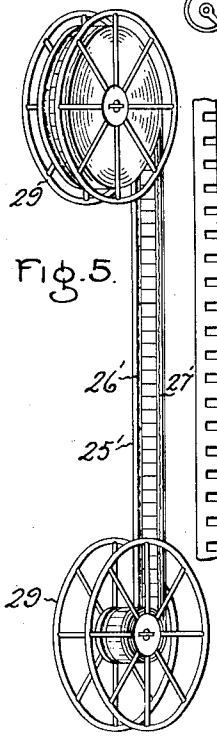


Fig. 5.

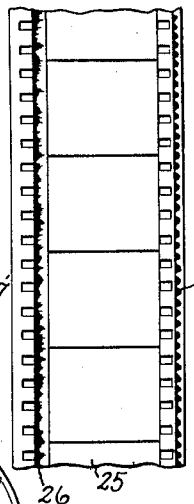


Fig. 3.

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UNITED STATES PATENT OFFICE

ELLSWORTH D. COOK, OF FLUSHING, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

SYNCHRONIZING REPRODUCING APPARATUS

Application filed September 12, 1929. Serial No. 392,193.

My invention relates to the reproduction of motion pictures or sounds or both from previously made records, each complete record comprising a plurality of separate unit portions from which the reproduction is made consecutively by successively operated units of the reproducing apparatus. In the projection of motion pictures from a record comprising more than a single reel of film it is common to employ two similar projectors and operate them successively to project the entire series of pictures without interruption from the several reels. Various means have been provided to enable the operator at the proper time to start another projector and to transfer the projection from the one to the other, it being understood that the latter part of the picture record of one reel is duplicated at the beginning of the next. To simplify the transfer of the projection the shift from the one machine to the other is often made while a subtitle is being shown where discrepancies in exact synchronism are not readily detected. If, however, the shift must be made during the showing of action, exact synchronism is required. Such is imperative in the case where sound is being reproduced from the record, it being equally true whether the sound record is on the same film as the picture record, or on a film by itself or is on a plurality of phonograph discs being continued from one to another for successive operation. It is the object of my invention to provide an improved method and apparatus useful in reproducing operations such as mentioned above for enabling the operator easily to effect exact synchronism between two record units prior to shifting the reproduction from the one to the other.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 shows two projector-reproducer units involving my invention and arranged for consecutive operation; Fig. 2 is a detail of the motor drive for each unit; Fig. 3 shows a short piece of a film print adapted for use in the units; Figs. 4 and 5 show two consecutive reels of film on which portions of the same picture and sound records are duplicated and which contain a tone record for synchronizing purposes; and Fig. 6 shows portions of the same films with the synchronizing tone reproducing means.

In Fig. 1, I have shown apparatus for the projection motion pictures and the reproduction of sounds from a film bearing both picture and sound records. This apparatus comprises two similar units 1 and 2 each shown as comprising a base 3, housing 4 containing the projecting and reproducing mechanism, the lamp housing 5, etc. Attached above and below to the housing 4 are the usual reel enclosures 6 containing the take-off and take-up reels for the combined picture and sound record film. In the upper portion of the housing 4 is the picture projecting apparatus which may be of any well known construction and in the lower portion of the housing is the sound reproducing apparatus which also may be of well known construction. The film in each unit is driven by a constant speed electric motor, preferably a synchronous motor shown at 7 supported by a bracket integral with the housing 4 and connected with the film driving mechanism within the housing 4 by means of a differential gear arrangement contained in the casing 8. This gear arrangement, shown on a larger scale in Fig. 2, is for the purpose of permitting the operator to vary the angular relation of shaft 10 which operates the film moving mechanism housing 4 and the motor shaft 11 and may be of any suitable and well known construction. It is shown, for example, as comprising the bevel gears 12 and 13 securred respectively to shafts 10 and 11 with which mesh the two planetary gears 14 and 15 carried by the ring gear 16. The latter is a worm gear and meshing with it is the worm 17 with which is connected the handle 18. The motors of the two units are shown connected with the common supply circuit 20 through the control switches 21 and 22.

As has already been mentioned above, the two units 1 and 2 are adapted for successive operation in order that the exhibition may

be continued to the end without interruption even though its length requires the use of several reels of film. The film may bear a record of motion pictures only or may bear a combined motion picture and sound record. In either case the record on the latter part of the film of one reel, say, for example, the last 75 feet thereof, is duplicated on the fore part of the film of the next reel. This duplication is effected by starting the second camera in the case of a picture record only or the second camera and second sound recorder in the case of a picture-sound record before the first camera or camera and recorder has reached the end of its reel of film. Thus there is an interval during which both cameras or both cameras and sound recorders are in simultaneous operation and duplicate records are made on the films. The desired length of duplicated film also may be produced by printing from the original negative. At or adjacent the duplicated part of the record I form on both films at some convenient point thereof not otherwise occupied, as, for example, between one edge and the adjacent row of sprocket holes, a sound record of gradually varying pitch such as a musical note whose pitch steadily increases or steadily decreases. In Fig. 3 I have illustrated a small section of a combined picture and sound film print 25 including the duplicated portion of the record showing at 26 the regular sound record which accompanies the pictures and at the opposite edge of the film the record 27 of the steadily varying note. The steadily varying note may be recorded on the original negatives or may be separately recorded and by the aid of suitable reference marks thereon and on the negatives may be printed in the proper corresponding positions on the positive films of the two reels opposite the duplicated portions of records.

In Fig. 4 I have shown the upper and lower reels 28 which during reproduction occupy the enclosures 6 of unit 1 with the film nearly all unwound from the upper reel on the lower reel and showing that part of the film which bears the duplicated record and the steadily varying tone. Similarly in Fig. 5 I have shown the upper and lower reels 29 which during reproduction occupy the enclosures 6 of unit 2 and the film connecting them bearing the duplicate sound record 26′ and gradually varying tone record 27′ but with this difference, namely, that the film has just begun to unwind from the upper to the lower reel. Film 25 may be considered for convenience that of the first reel of the complete film record and film 25′ that of the second reel. If the record includes a third reel the latter portion of the film 25′ of the second reel will be duplicated on the fore part of the film of the third reel and the duplicated portions will also bear the gradually varying tone record as before. The purpose of the duplicate gradually varying tone record on the two films is to facilitate bringing the two units in exact synchronism prior to the transfer of the reproduction from one unit to the next.

In each of the units 1 and 2, see Fig. 6, I provide means for translating the gradually varying tone record into corresponding current impulses which upon being suitably amplified are converted into sound by means of a telephone of loud speaker. As a part of each unit I have shown by way of example the light source 32, the optical means 33 for focusing to a narrow line the light rays therefrom on the respective tone records 27 and 27′ and behind each film the photo-electric cell 34 in a position to receive the rays modified by the tone record. The photo-electric cells 34 are each connected to a suitable circuit extending to the amplifier 35 from which the respective circuits may connect with the two ear pieces of a head-set worn by the operator or may connect with a single loudspeaker 36 as illustrated.

When a sound-picture is being exhibited from a film of the character described comprising a plurality of reels and by the use of apparatus such as shown and described, the operator will exhibit the first reel, say in unit 1, and while that unit is running will thread up unit 2 with the second reel and have it ready to start. When the first reel of film is nearly exhausted, the operator receives a signal to advise him to start the second unit by closing switch 22, turning on the lamps, etc. This signal which preferably is preceded by a warning signal may be recorded on the edge of the film as indicated at 27 and may be received by the operator through his head set or through the loudspeaker 36 arranged in the projection booth. After a short interval following the start signal, sufficient time being allowed for the second unit to come up to full speed, the operator begins to hear the constantly varying note recorded at 27 and 27′ from each unit. If he is using a head set one receiver of the pair may be connected to the output of the photo-cell 34 of one unit and the other receiver connected to the output of the photo-cell 34 of the other unit in which case he hears individually with his two ears the respective tones from the two projectors. If he employs a single loudspeaker as shown at 36 the two tones are combined. The speeds of the two units necessarily are the same and unless the two units happen to be in exact synchronism, that is, the same picture and sound being reproduced at the same instant by both units, the two tones heard by the operator from the two units will not have the same pitch and if the difference is not too great a beat note will be heard. The operator thereupon recognizing that the film in unit 2 is slightly ahead or behind that of unit 1 turns the handle 18 of the differential of unit

2 in the direction to reduce the lead or lag as indicated by the change in the beat note. When the operator is satisfied that exact synchronism is obtained the picture projection and sound reproduction may be thrown from unit 1 to unit 2 in the well known manner. Unit 1 after coming to rest may then be reloaded with the third film reel of the series if there be one and at the end of reel 2, unit 1 re-started and synchronized with unit 2 in a manner similar to that just described.

While I have shown and described a film having both picture and sound records thereon it will be understood that my invention is applicable to a film having a picture record only or a sound record only, nor is it limited to a film having a photographic record thereon but is applicable to any other form of sound record carrier whereon the sound record is made other than photographically.

I have chosen the particular embodiment described above as illustrative of my invention and it will be apparent that various modifications may be made without departing from the spirit and scope of my invention, which modifications I aim to cover by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. In apparatus for reproducing without interruption a record continued from one record carrier to another, a plurality of similar record carriers, the latter part of the record of the first being duplicated at the fore part of the other, said record carriers having a synchronizing record thereon at portions corresponding to said parts.

2. In apparatus for reproducing without interruption a record continued from one record carrier to another, a plurality of similar record carriers, the latter part of the record of the first being duplicated at the fore part of the other, said record carriers having thereon at portions corresponding to said parts a sound record of gradually varying pitch.

3. In apparatus for reproducing without interruption a record continued from one record carrier to another, a plurality of similar record carriers the latter part of the record of one being duplicated at the fore part of the next, said record carriers having adjacent said portions a sound record of gradually varying pitch.

4. In apparatus for reproducing consecutively from a plurality of films without interruption a record continued from one film to the next, a plurality of films the latter part of the record on one being duplicated on the fore part of the next, said films having on their respective latter and fore parts a sound record gradually varying in pitch.

5. In apparatus for reproducing consecutively from a plurality of films without interruption a record continued from one film to the next, a plurality of films the record on the latter part of one being duplicated on the fore part of the next, said films having on their respective latter and fore parts a sound record comprising a warning signal and a subsequent sound record comprising a synchronizing signal.

6. The method of operating reproducing apparatus composed of a first and a second unit adapted successively to move consecutive portions of a complete record of which portions the latter part of the first is duplicated on the fore part of the second and both portions have recorded thereon a similar series of vibrations of gradually varying frequency which comprises starting the second unit while the first is still running, and varying the speed of the second unit in accordance with the difference in frequency of the vibrations reproduced from the record portions by the two units.

7. The method of operating reproducing apparatus composed of a first and a second unit adapted successively to move consecutive portions of a complete record of which portions the latter part of the first is duplicated on the fore part of the second and both parts bear a record of a sound gradually varying pitch which comprises starting the second unit while the first is still running, listening to the sounds reproduced from the sound records of the two units and varying the speed of the second unit in accordance with the relation of the sounds.

8. The method of operating reproducing apparatus composed of a first and a second unit adapted successively to move separate consecutive lengths of a complete record of which lengths the record on the latter part of the first is duplicated on the fore part of the second and said lengths have on the corresponding parts thereof a sound record of gradually varying pitch which method comprises starting the second unit at a predetermined time while the first unit is still running, listening to the sounds reproduced from the sound records of the two units, varying the speed of the second unit until the beat note resulting from said sounds has substantially zero frequency, and finally transferring the reproduction from the first to the second unit.

In witness whereof, I have hereto set my hand this 26th day of August, 1929.

ELLSWORTH D. COOK.